



Energy Efficiency and Renewable Energy
Federal Energy Management Program

How to Buy Energy-Efficient Commercial Downlight Luminaires

Why Agencies Should Buy Efficient Products

- Executive Order 13123 and FAR section 23.704 direct agencies to purchase products in the upper 25% of energy efficiency, including all models that qualify for the EPA/DOE ENERGY STAR[®] product labeling program.
- Agencies that use these guidelines to buy efficient products can realize substantial operating cost savings and help prevent pollution.
- As the world's largest consumer, the federal government can help "pull" the entire U.S. market towards greater energy efficiency, while saving taxpayer dollars.

Federal Supply Source:

- General Services Administration (GSA)
Phone: (817) 978-8640
www.fss.gsa.gov

For More Information:

- DOE's Federal Energy Management Program (FEMP) Help Desk and World Wide Web site have up-to-date information on energy-efficient federal procurement, including the latest versions of these recommendations.
Phone: (800) 363-3732
www.eren.doe.gov/femp/procurement
- FEMP's *Federal Lighting Guide* provides helpful guidance on lighting projects.
Phone: (800) 363-3732
www.eren.doe.gov/femp/resources/lighting.html
- National Electrical Manufacturers Association (NEMA) publishes Standards Publication LE 5A, *Procedure for Determining Luminaire Efficacy Ratings for Commercial, Non-Residential Downlight Luminaires*.
Phone: (800) 854-7179
www.nema.org
- Lighting Research Center's National Lighting Product Information Program (NLPIP) publishes a downloadable "Specifier Report" on CFL downlights.
Phone: (518) 276-8716
www.lrc.rpi.edu/NLPIP/online/pubs.html
- Lawrence Berkeley National Laboratory provided supporting analysis for this recommendation.
Phone: (202) 646-7950

Efficiency Recommendations^a

Luminaire Type (NEMA designation)	Recommended LER	Best Available LER
Compact Fluorescent Lamps (CFLs)		
Open Optics	29 or higher	57
Baffled Optics	21 or higher	41
Lensed Optics	24 or higher	48
Metal Halide Lamps		
Open Optics	35 or higher	55
Lensed Optics	30 or higher	43

a) This Recommendation pertains to downlight luminaires with compact fluorescent lamps from 13 to 32 watts (about 700 - 1,400 lumens), and metal halide lamps under 150 watts (about 12,000 lumens).

The federal supply source for commercial downlight luminaires is the General Services Administration (GSA), which offers them on Schedule 62-II, as well as through its on-line shopping network, *GSA Advantage!* Whether buying through GSA or commercially, make sure to select or specify models that meet the recommended level for that luminaire type, based on NEMA standard LE 5A (see "For More Information").

LER ratings may not be available for some products. For compact fluorescent lamp downlights, if an LER is not available, buyers should specify a model with an electronic ballast and estimate the LER using this formula:

$$\text{LER} = 63 \times \text{Luminaire Efficiency}$$

where 63 represents a conservative combined lamp-ballast efficacy for a CFL with electronic ballast. Luminaire efficiency may be found in manufacturers' luminaire photometric reports and in some product catalogues.

Definitions

Downlight is a small, ceiling-mounted direct lighting unit that casts its light downward.

Luminaire is a complete lighting unit consisting of a fixture along with one or more ballasts and lamps.

Luminaire Efficacy Rating (LER) describes the efficiency of a luminaire in terms of rated light output (in lumens) per watt of electricity use.

Lumen is a measure of light output.

Baffle is a light-absorbing element within the luminaire.

How to Select Energy-Efficient Downlight Luminaires

Definitions

Lamp-Ballast Efficacy describes the efficiency of a lamp and ballast together, in lumens per watt. Higher wattage lamps generally have higher efficacies.

Luminaire Efficiency (LE) is the luminaire's light output, in lumens, divided by the total rated lamp lumens.

For metal halide downlights, LER can also be estimated from a manufacturer's photometric data, with this formula:

$$\text{LER} = \left(\frac{\text{Lamp Lumens} \times \text{Luminaire Efficiency}}{\text{Input Watts}} \right)$$

Incandescent downlights or reflector lamps are the least efficient light source and are not recommended for general lighting. Electronic (not magnetic) ballasts are recommended for CFL downlights. Some CFL electronic ballasts offer dimming capabilities. For metal halide lamps, electronic ballasts often provide reduced size and weight, as well as improved color rendering, but efficiency gains compared with magnetic ballasted models are minor.

"Pulse start" metal halide lamps and compatible, energy-efficient ballasts reduce input watts and also increase light output (lumens) compared to standard metal halide lamps. Input watts may be reduced by up to 25%, resulting in improved LERs. Pulse-start lamps also provide faster re-strike, improved color rendering and stability, and longer lifetimes.

Capacitive switching with special metal halide ballasts can provide bi-level lighting control for use with occupancy sensors in warehouses, garages, or other areas with intermittent occupancy. Because of the delay in re-strike time, it is generally not practical to shut off metal halide lights completely except for extended periods of non-occupancy. In the lower-power standby mode, light output ranges from 15% to 40% of full light output with power levels from 30% to 60% of full rated power.

Buyer Tips

Definition

Color Rendering Index (CRI) measures the quality of color rendition compared with a reference light source. CRI has a maximum of 100. Metal halide lamps generally have lower CRIs than compact fluorescent lamps.

Comm. Downlight Luminaire Cost-Effectiveness Example (CFL, Open Optics)

Performance	Base Model	Recommended Level	Best Available
Luminaire Efficacy Rating (LER)	16	29	57
Luminaire Light Output	1250 lumens	1450 lumens	1540 lumens
Power Input	78 watts	50 watts	27 watts
Annual Energy Use	281 kWh	180 kWh	97 kWh
Annual Energy Cost	\$17	\$11	\$6
Lifetime Energy Cost	\$175	\$115	\$60
Lifetime Energy Cost Savings	-	\$60	\$115

Definition

Lifetime Energy Cost is the sum of the discounted value of annual energy costs, based on average usage and an assumed luminaire life of 15 years. Future electricity price trends and a discount rate of 3.4% are based on federal guidelines (effective from April, 2000 to March, 2001).

Cost-Effectiveness Assumptions

Energy use is based on 3,600 operating hours/year. The Base Model uses a magnetic ballast, while the Recommended and Best Available luminaires have electronic ballasts. Lifetime energy costs and savings are based on a 15-year luminaire lifetime; six lamps would be used over this period. The assumed electricity price is 6¢/kWh, the federal average electricity price (including demand charges) in the U.S.

Using the Cost-Effectiveness Table

In the example above, the luminaire at the Recommended Level is cost-effective if its price does not exceed the price of the Base Model by more than \$60. The Best Available luminaire is cost-effective if its price does not exceed the price of the Base Model by more than \$115.

What if my Electricity Price or Hours of Use are different?

To calculate annual or lifetime savings for a different electricity price, multiply the savings in the above table by this ratio: $\left(\frac{\text{Your price in } \text{¢/kWh}}{6.0 \text{ ¢/kWh}} \right)$. Similarly, for a different hours of use figure, multiply savings by this ratio: $\left(\frac{\text{Your yearly hours of use}}{3,600} \right)$.

